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Indian Standard

SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

Fifth Reprint SEPTEMBER 2007
(Including Amendment Nos. 1, 2, 3, 4 & 5)

UDC 621.315.624 : [621.315.612.2] : 621.315.1

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6

May 1977

AMENDMENT NO. 5 JANUARY 1993
TO
IS 1445 : 1977 SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

(*Page* 21, *Table* 3) — Substitute the following for the existing table:

'TABLE 3 SAMPLE SIZE, ACCEPTANCE AND THE REJECTION NUMBERS

(*Clause* B-1.1)

Lot Size (1)	First Sample Size (2)	Second Sample Size (3)	Acceptance Number (4)	First Rejection Number (5)	Second Rejection Number (6)
Up to 500	8	8	0	2	2
501 ,, 1 000	13	13	0	3	4
1 001 ,, 3 000	20	20	1	4	5
3 001 ,, 10 000	32	32	2	5	7
10 001 ,, 35 000	50	50	3	7	9
35 001 and above	80	80	5	9	13

(*Page* 21, *clause* **B-2**) — Substitute the following for the existing clause:

'B-2 CRITERIA FOR CONFORMITY

B-2.1 The number of insulators selected at random in accordance with col 1 and 2 of Table 3 shall be subjected to all the acceptance tests. An insulator failing to meet any of the requirements for acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements of acceptance tests if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number. The lot shall be rejected if the number of defectives is greater than or equal to the corresponding first rejection number (*see* col 5 of Table 3). If the number of defectives is in between the acceptance number and first rejection number, then a second sample of same size shall be selected from the lot at random and subjected to all the acceptance tests. The lot shall be considered as conforming to the requirements of acceptance tests, if the combined number of defectives in both the samples is less than the second rejection number (*see* col 6 of Table 3); otherwise not.'

(ETD 06)

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AMENDMENT NO. 4 OCTOBER 1991
TO
IS 1445 : 1977 SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

(*Page* 14, *clause* 8.8.2, *first sentence*) — Substitute the following for the existing sentence:

'The complete test shall comprise five transfers; hot to cold, cold to hot, hot to cold, cold to hot, and hot to cold.'

(ETDC 6)

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AMENDMENT NO. 3 JANUARY 1989
TO
IS : 1445 - 1977 SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

(*Page* 8, *clause* **4.5**, *line* 4) — Insert the following at the end :

"The thickness of hexagon nuts shall be in accordance with IS : 1363 (Part 3) - 1984 'Hexagon head bolts, screws and nuts of product grade C : Part 3 Hexagon screws (size range M 5 to M 36) (*second revision*)'."

(ETDC 3)

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AMENDMENT NO. 2 FEBRUARY 1981

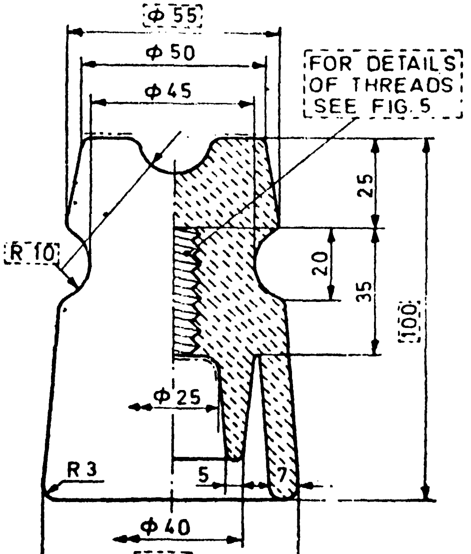
TO

IS : 1445-1977 SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

Alteration

(*Page* 6, *Fig.* 1) — Substitute the following for the existing figure:



NOTE 1 — The upper groove of the pin insulators should be slightly slanting so that the possibility of damage to the conductor on the sharp edge is avoided.

NOTE 2 — Threads and portions marked ---- shall be unglazed.

All dimensions in millimetres.

FIG. 1 PIN INSULATOR — TYPE 1

(ETDC 3)

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AMENDMENT NO. 1 NOVEMBER 1979

TO

IS : 1445-1977 SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V

(Second Revision)

Alteration

(*Page* 11, *clause* 7 *and* 7.1) — Delete and renumber the subsequent clauses accordingly.

(ETDC 3)

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Indian Standard
SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V
(Second Revision)

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(*Continued on page* 2)

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(Continued from page 1)

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Indian Standard
SPECIFICATION FOR PORCELAIN INSULATORS FOR OVERHEAD POWER LINES WITH A NOMINAL VOLTAGE UP TO AND INCLUDING 1 000 V
(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 28 January 1977, after the draft finalized by the Electrical Insulators and Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard has been prepared to achieve the following objectives:

a) To define the terms used,

b) To define insulator characteristics and to prescribe the conditions under which the specified values of these characteristics shall be verified,

c) To prescribe test methods, and

d) To prescribe acceptance criteria.

0.3 This standard was originally issued in 1959. Its first revision was published in 1966 to include a sampling plan for selections of insulators for acceptance tests.

0.3.1 This second revision has been undertaken with a view to rationalizing the classification of tests specified in the standard and to align the test procedures and requirements with those given in other electrical insulator standards.

0.4 With a view to limiting the number of types and sizes of both pin and shackle insulators, this standard specifies only two types in each. To achieve uniformity of manufacture and interchangeability important overall dimensions have been given.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with

IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies requirements and methods of sampling and tests for porcelain insulators for overhead power lines with a nominal voltage up to and including 1 000 V. Both pin and shackle type insulators are covered.

1.2 It does not apply to insulators forming part of electrical apparatus or to porcelain parts used in their construction.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Pin Insulator — An insulator consisting of a single piece of porcelain and intended to be mounted rigidly on a supporting structure by a pin which passes up inside the insulator. Unless otherwise stated, the term excludes the insulator pin.

2.2 Insulator Pin — A rigid fitting for attaching a pin insulator to a supporting structure.

2.3 Shackle Insulator — An insulator consisting of a single piece of porcelain and intended to be mounted vertically or horizontally between and in contact with the two ends of a 'U' strap or a pair of straps with its axis vertical and intended to secure a line conductor in tension. The term excludes the 'U' strap or other straps for attaching the insulator to a supporting structure.

2.4 Lot — All the insulators of the same type and design manufactured under similar conditions of production, offered for acceptance; a lot may consist of the whole or part of the quantity ordered.

2.5 Dry or Wet Power-Frequency Flashover Voltage — The arithmetic mean value of the measured power-frequency voltages which cause flashover of the insulator under the conditions prescribed in **8.6** and **8.7**.

2.6 Dry or Wet Power-Frequency withstand Voltage — The specified power-frequency voltage which the insulator shall withstand, dry or wet, under the conditions prescribed in **8.6** and **8.7** for the specified time (one minute) without flashover or puncture.

---

*Rules for rounding off numerical values (*revised*).

2.7 Mechanical Failing Load — The maximum load which can be reached when a insulator is tested under the conditions prescribed in **8.9**.

2.7.1 *Specified Minimum Failing Load* — The minimum failing load specified by the purchaser or declared by the supplier (*see* Table 1).

2.8 Puncture — A distruptive discharge passing through the solid insulating parts of an insulator.

NOTE — A fragment breaking away from the rim of a shed or damage to the insulator due to the heat of a surface discharge is not considered a puncture.

2.9 Type Tests — Tests carried out to prove conformity with the specification. These are intended to prove the general qualities and design of a given type of insulator.

2.10 Acceptance Tests — Tests carried out on samples taken from the lot for the purpose of acceptance of the lot.

2.11 Routine Tests — Tests carried out on each insulator to check requirements which are likely to vary during production.

3. REFERENCE ATMOSPHERIC CONDITIONS

3.1 Reference atmospheric conditions at which insulator characteristics shall be expressed for the purpose of comparison shall be as given below:

Ambient temperature	20°C
Barometric pressure	1 013 millibars
Absolute humidity	11 g of water per cubic metre corresponding to 63 percent relative humidity at 20°C

NOTE 1 — A pressure of 1 013 mbar is equivalent to a pressure of 760 mmHg at 0°C. If the height of the barometer is h mmHg and the temperature of the mercury is t°C, the atmospheric pressure in millibars is:

$$p = \frac{1\,013\,h}{760}\,(\,1 - 1{\cdot}80 \times 10^{-4t}\,)$$

NOTE 2 — The Indian Standard reference temperature of 27°C and corresponding humidity have not been specified because of the non-availability of the test voltage values and correction factors for these conditions. These conditions will replace those specified above when the corresponding test voltage values and correction factors are available.

3.2 Tests for the purpose of this standard shall preferably be carried out under conditions of temperature and humidity specified in IS : 196-1966* (that is, a temperature of 27 ± 2°C and relative humidity of 65 ± 2 percent), and at the prevailing atmospheric pressure. When this is not possible, test may be carried out under conditions naturally obtaining at the time of the test. The barometric pressure, air temperature and humidity shall be recorded for the purpose of corrections. Corrections of test voltages for atmospheric conditions are given in Appendix A.

---

*Atmospheric conditions for testing (*revised*).

4. GENERAL REQUIREMENTS

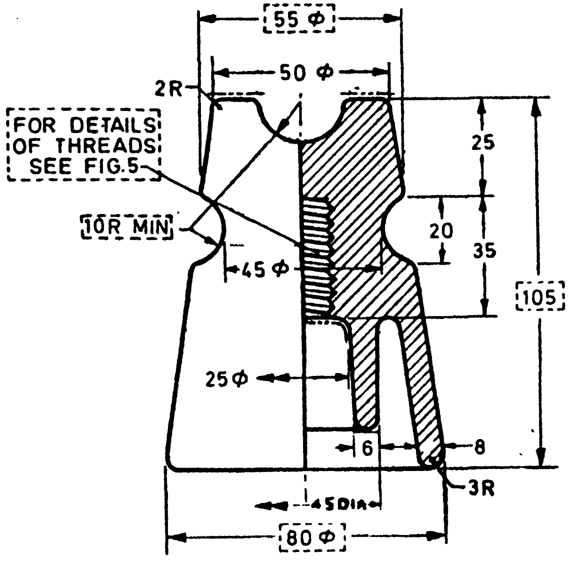
4.1 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

4.2 The design of the Insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration.

4.3 The glaze, unless otherwise specified, shall be brown in colour. Except for the screw threads and the parts on which the porcelain is supported during firing, which may be left unglazed, all other surfaces of the insulator shall be effectively glazed.

4.4 The insulators shall be in one piece. The pin type insulator shall have a top groove and have dimensions as shown in Fig. 1 and 2, and the shackle type shall have dimensions as shown in Fig. 3 and 4.

NOTE — In Fig. 1 to 4, the enclosed dimensions are mandatory. Other dimensions and the profile are given for guidance. Insulators having different non-mandatory dimensions and profile shall be acceptable provided they conform to this standard in all other respects.

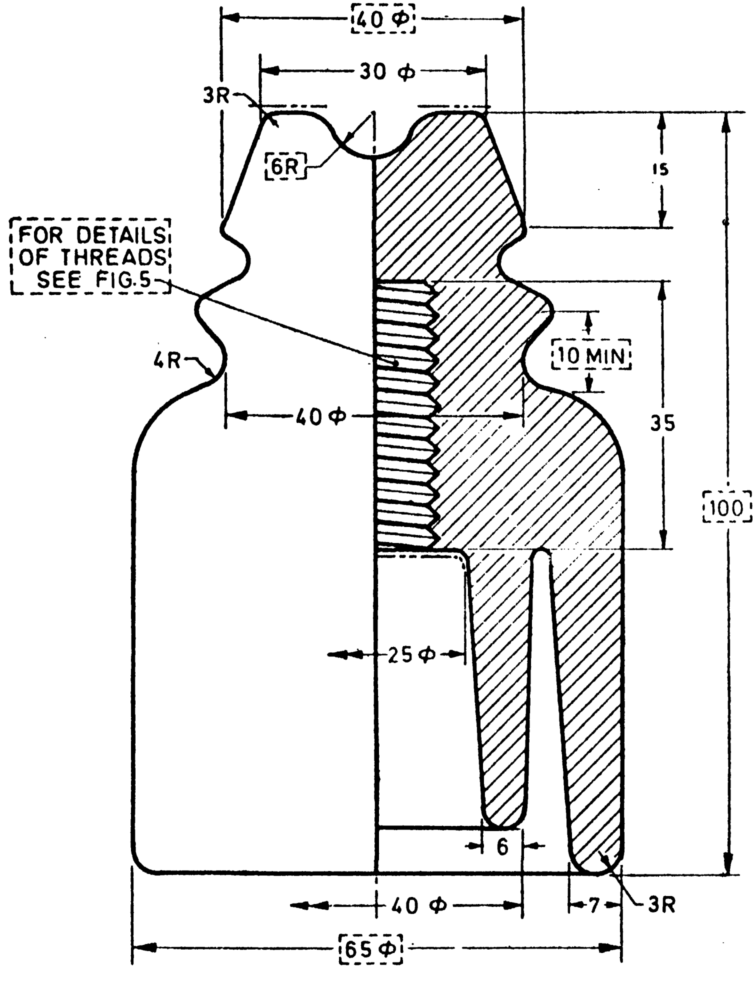


NOTE 1 — The upper groove of the pin insulators should be slightly slanting so that the possibility of damage to the conductor on the sharp edge is avoided.

NOTE 2 — Threads and portions marked----shall be unglazed.

All dimensions in millimetres.

FIG. 1 PIN INSULATOR — TYPE 1

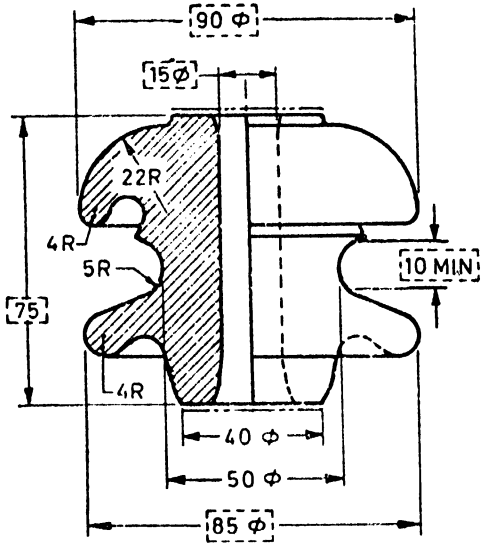


NOTE 1 — The upper groove of the pin insulators should be slightly slanting so that the possibility of damage to the conductor on the sharp edge is avoided.

NOTE 2 — Threads and portions marked ---- shall be unglazed.

All dimensions in millimetres.

FIG. 2 PIN INSULATOR — TYPE 2



NOTE 1 — The portions marked ---- shall be unglazed.

NOTE 2 — The unglazed portion marked at the top and bottom of the insulators is meant for supporting the insulators during firing. While determining the areas for glaze faults, only one portion should be permitted as unglazed as only one portion (that is, top or bottom) would be required for supporting during firing.

All dimensions in millimetres.

FIG. 3 SHACKLE INSULATOR — TYPE 1

4.5 The pin insulators shall be threaded to take mild steel pins, the profile of threads being as given in Fig. 5. The shackle insulators shall have a ' U ' strap or a pair of straps and a cotter pin or two bolts and nuts, having threads in accordance with IS : 4218 (Part VI)-1967*.

5. INSULATOR CHARACTERISTICS

5.1 Insulators shall have the electrical and mechanical characteristics given in Table 1.

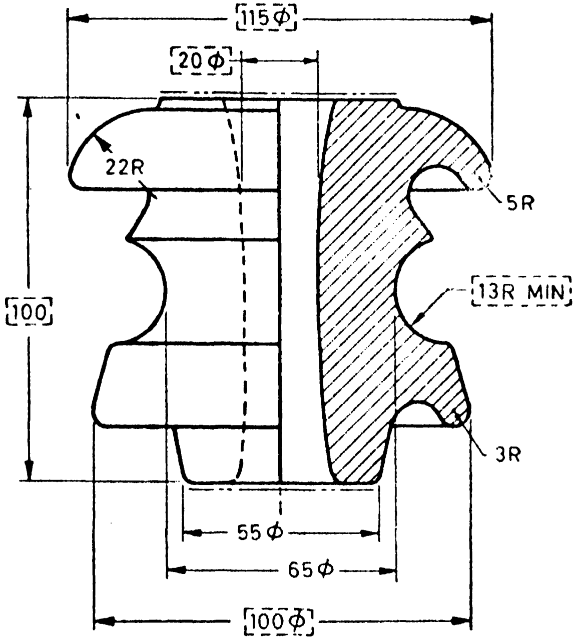
---

*ISO metric screw threads: Part VI Limits of sizes for commercial bolts and nuts (diameter range 1 to 39 mm).

TABLE 1 CHARACTERISTICS OF INSULATORS

(*Clauses* 5.1, 8.6.2, 8.7.3, 8.9.1 *and* 8.9.2)

TYPE OF INSULATOR (1)	DRY POWER FREQUENCY WITHSTAND VOLTAGE (2) kV (rms)	WET POWER FREQUENCY WITHSTAND VOLTAGE (3) kV (rms)	POWER-FREQUENCY PUNCTURE WITHSTAND VOLTAGE (4) kV (rms)	MINIMUM FAILING LOAD (5) kN
Pin	23	10	1·3 × the actual dry flashover voltage	3·5
Shackle	23	10	1·3 × the actual dry flashover voltage	11·5 (Type 1) 16·0 (Type 2)

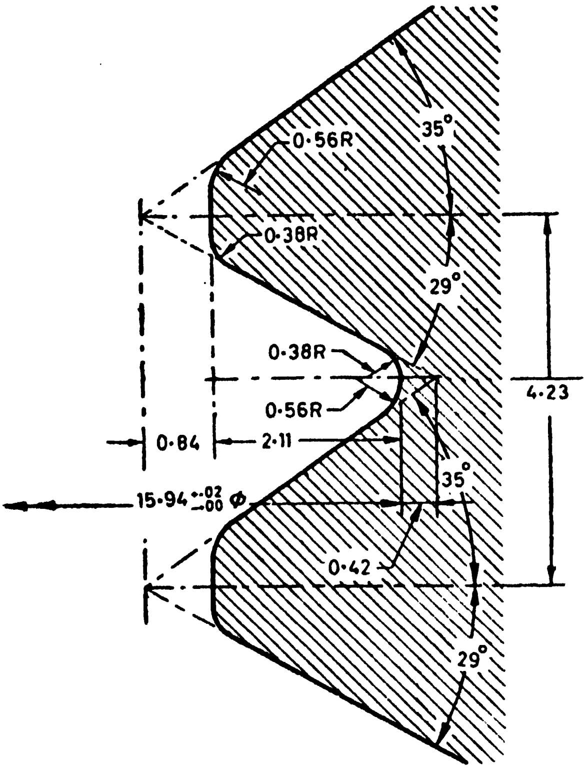


NOTE 1 — The portions marked ---- shall be unglazed.

NOTE 2 — The unglazed portion marked at the top and bottom of the insulators is meant for supporting the insulators during firing. While determining the areas for glaze faults, only one portion should be permitted as unglazed as only one portion (that is, top or bottom) would be required for supporting during firing.

All dimensions in millimetres.

FIG. 4 SHACKLE INSULATOR — TYPE 2



All dimensions in millimetres.

FIG. 5 PROFILE OF INSULATOR THREADS

6. MARKING

6.1 Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trade-mark of the manufacturer,

b) Month and year of manufacture, and

c) Country of manufacture.

6.1.1 Markings on porcelain shall be printed and shall be applied before firing.

6.2 The product may also be marked with Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufactures or producers may be obtained from the Bureau of Indian Standards.

7. PACKING

7.1 Insulators shall be packed in crates or boxes suitable for rough handling.

8. TESTS

8.1 Type Tests — The following tests shall constitute the type tests:

a) Visual examination (**8.4**),
b) Verification of dimensions (**8.5**),
c) Dry power-frequency voltage withstand test (**8.6**),
d) Wet power-frequency voltage withstand test (**8.7**),
e) Temperature cycle test (**8.8**),
f) Mechanical failing load test (**8.9**),
g) Power-frequency puncture withstand test (**8.10**), and
h) Porosity test (**8.11**).

Note 1 — Type tests are normally made once and unless otherwise agreed to, test certificate giving the results of type tests, made on not less than two insulators identical in all essential details with those to be supplied, are regarded as evidence of compliance. The tests should be carried out on two samples in the order mentioned below:

a) Tests on both insulators:
  1) Visual examination (**8.4**),
  2) Verification of dimensions (**8.5**),
  3) Dry power-frequency voltage withstand test (**8.6**),
  4) Wet power-frequency voltage withstand test (**8.7**), and
  5) Temperature cycle test (**8.8**).
b) Tests on first insulator:
  1) Mechanical failing load test (**8.9**), and
  2) Porosity test (**8.11**).
c) Tests on second insulator:
  Power-frequency puncture withstand test (**8.10**).

Note 2 — Type test shall be made by the manufacturer or by an agreed independent authority.

8.2 Acceptance Tests — The test samples shall be subjected to the following acceptance tests in the order indicated below:

a) Verification of dimensions (**8.5**),

b) Temperature cycle test (**8.8**),

c) Mechanical failing load test (subject to mutual agreement between the purchaser and the supplier) (**8.9**), and

d) Porosity test (**8.11**).

8.2.1 For carrying out acceptance tests specified in standard, the sampling procedure given in Appendix B shall be followed.

8.3 Routine Test — The visual examination shall be carried out on each insulator.

8.4 Visual Examination

8.4.1 Visual examination shall be made on each insulator. The colour of the insulator shall approximate to the colour specified. Some variation in the colour shade is permitted and shall not justify rejection of the insulator. The insulator shall be free from physical distortion of shape within tolerances specified.

8.4.2 The areas specified as glazed on the drawing shall be covered by a smooth hard glaze free from cracks and other defects prejudicial to satisfactory performance in service.

8.4.3 Out of those areas specified as glazed on the drawing, the total area not covered by glaze shall not exceed:

$$1+\frac{DF}{2\ 000}\ \text{mm}^2$$

Also the area of any single glaze defect shall not exceed:

$$0{\cdot}5+\frac{DF}{20\ 000}\ \text{mm}^2$$

where

D = greatest diameter of the insulator in mm, and

F = creepage distance of the insulator in mm.

8.5 Verification of Dimensions — It shall be verified that the insulator is in accordance with the relevant drawings. Unless otherwise specified, a tolerance of $\pm(0{\cdot}04\,d+1{\cdot}5)$mm shall be allowed for all dimensions, d being the dimension in millimetres. The insulator threads shall be checked with gauges given in IS :283-1976*.

---

*Specification for porcelain insulators for telegraph and telephone lines (*third revision*).

8.6 Dry Power-Frequency Voltage Withstand Test

8.6.1 The insulator shall be tested in accordance with Appendix C.

8.6.2 The test voltage to be applied to the insulator shall be the specified value of the dry power-frequency withstand voltage in Table 1 adjusted for atmospheric conditions at the time of test (*see* Appendix A).

8.6.3 A voltage of about 75 percent of the test voltage as determined in **8.6.2** shall be applied and then increased gradually to reach the test voltage in a time not less than 5 seconds. The test voltage shall be maintained at this value for 1 minute [*see* IS : 2071 (Part II)-1974*].

The insulator shall not flashover or puncture during the application of the test voltage.

8.6.4 To provide information when specially requested, the dry flashover voltage of the insulator may be determined by increasing the voltage gradually from about 75 percent of the dry power-frequency withstand voltage to reach the flashover voltage in not less then 5 seconds. The flashover voltage shall be the arithmetic mean of five consecutive readings and the value after correction to standard atmospheric conditions (*see* Appendix A) shall be recorded.

8.7 Wet Power-Frequency Voltage Withstand Test

8.7.1 The insulator shall be arranged as prescribed in Appendix C.

8.7.2 Before the commencement of the test, the insulator shall be exposed to the artificial rain produced in accordance with **3.3** of IS : 2071 (Part I)-1974† for at least 1 minute before application of voltage and then throughout the test.

8.7.3 The test voltage to be applied to the insulator shall be the specified value of the wet power-frequency withstand voltage in Table 1 adjusted for atmospheric conditions at the time of test (*see* Appendix A).

8.7.4 A voltage of about 75 percent of the test voltage as determined in **8.7.3** shall be applied and then increased gradually to reach the test voltage in a time not less than 5 seconds. The test voltage shall be maintained at this value for 1 minute [*see* IS : 2071 (Part II)-1974*].

The insulator shall not flashover or puncture during the application of the test voltage.

8.7.5 To provide information when specially requested, the wet flashover voltage of the insulator may be determined by increasing the voltage

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*Methods of high voltage testing: Part II Test procedures (*first revision*).

†Methods of high voltage testing: Part I General definitions and tests requirements (*first revision*).

gradually from about 75 percent of the wet withstand voltage to reach the flashover voltage in not less than 5 seconds. The flashover voltage shall be the arithmetic mean of five consecutive readings and the value after correction to standard atmospheric conditions (*see* Appendix A) shall be recorded.

8.8 Temperature Cycle Test

8.8.1 The pin insulators shall be with pins, but shackle insulators should be without ' U ' straps. The insulators shall be quickly and completely immersed, without being placed in an intermediate container, in a water-bath maintained at a temperature of 70°C higher than that of the cold bath used in the rest of the test and left submerged for a period of 15 minutes. They shall then be withdrawn and quickly and completely immersed, without being placed in an intermediate container, in a bath of cold water for the same period of 15 minutes.

8.8.2 The complete test shall comprise five transfers; cold to hot, hot to cold, cold to hot, hot to cold, cold to hot. The time taken to transfer and the insulators from one bath to the other shall be as short as possible and shall not exceed 30 seconds. The quantity of the water in the test tanks shall be sufficiently large for the immersion of the insulators so as not to cause a temperature variation of more than ± 5°C in the water.

8.8.3 After the completion of all the cycles of the immersion, the insulator shall be examined to verify that the insulating parts have not cracked, nor the fittings loosened (for pin insulators) and that the glaze is undamaged.

8.9 Mechanical Failing Load Test

8.9.1 The shackle insulator shall be mounted between close fitting parallel straps, using a special through-bolt of same diameter as that for which the insulator is designed. The straps shall be attached to a metal bracket on the testing machine. The insulator shall then be subjected to a tensile load equal to one-half of the specified minimum failing load, the load being applied in the plane of the external conductor groove by means of a loop of flexible wire rope with a diameter not exceeding the radius of the conductor groove. This load shall be steadily increased at a rate of about 20 percent of the specified minimum failing load per minute until the specified minimum failing load is reached. The insulator passes the test if the specified minimum failing load as given in Table 1 is reached without breakage.

8.9.1.1 To provide information when specially requested, the load may be increased until mechanical failing load as defined in **2.7** is reached and the value recorded.

8.9.2 Pin insulators shall be mounted on a rigidly fixed pin capable of withstanding, without appreciable deformation, the loads to which it will be subjected to during the test, the pin being attached to a metal bracket on the testing machine. The insulator shall then be subjected to a load equal to one-half of the specified minimum failing load applied perpendicular to its axis in the plane of the side groove by means of a flexible wire rope with a diameter not exceeding the radius of the conductor groove. The load shall then be increased at a rate of about 20 percent of the specified minimum failing load per minute until the specified minimum failing load is reached. The insulator passes the test if the specified minimum failing load as given in Table 1 is reached without breakage.

8.9.2.1 To provide information when specially requested, the load may be increased until the mechanical failing load as defined in **2.7** is reached and the value recorded.

8.10 Power-Frequency Puncture Withstand Test

8.10.1 The insulator shall be tested in accordance with Appendix C.

8.10.2 The insulators, after having been cleaned and dried, shall be completely immersed in a tank containing a suitable insulating medium to prevent surface discharges on them. If the tank is made of metal, its dimensions shall be such that the shortest distance between any part of the insulator and the side of the tank is not less than 1·5 times the diameter of the largest insulator shed. The power-frequency test voltage shall be applied as follows:

a) *For pin insulators* — Between a metal pin such as is used in service, fixed in the insulator, and a conductor held in the groove by a suitable binder.

b) *For shackle insulators* — Between a metallic spindle passing through the insulator packed with metal wool, foil or other conducting material to establish intimate contact throughout the spindle hole and a suitable electrode in intimate contact with the surfaces of the conductor groove.

8.10.3 During immersion in the insulating fluid, precaution shall be taken to avoid air pockets under insulator sheds. The voltage shall be increased rapidly to the specified dry one-minute power-frequency withstand voltage and then steadily increased at a rate of about 1 000 volts per second until the minimum specified puncture withstand voltage reached. No puncture shall occur at this voltage for the minimum time necessary to measure it.

8.10.4 To provide information when specially requested, the voltage may then be raised until puncture occurs and the puncture voltage noted for information.

NOTE 1 — If the test installation does not permit puncture to be obtained, the test may be stopped at 1·5 times the specified minimum puncture voltage.

NOTE 2 — It is not possible to define exactly the properties of the immersion medium, but one desirable property is a slight conductivity (resistivity of the order of 10^6 to 10^8 Ωm).

8.11 Porosity Test

8.11.1 Porcelain fragments from the insulators shall be immersed in one percent alcoholic solution of fuchsin (1 g fuchsin in 100 g of methylated spirit) under a pressure of not less than 15×10^6 N/m^2 for a period such that the product of the test duration in hours and the test pressure in N/m^2 is not less than 180×10^6.

8.11.2 The fragments shall then be removed from the solution, washed, dried and broken. Examination with naked eye of the freshly broken surface shall not reveal any dye penetration. Penetration into small cracks formed during the initial breaking shall be neglected.

APPENDIX A

(*Clauses* 3.2, 8.6.2, 8.6.4, 8.7.3 *and* 8.7.5)

CORRECTION OF TEST VOLTAGE FOR ATMOSPHERIC CONDITIONS

A-1. GENERAL

A-1.1 Variations in barometric pressure and air humidity of the atmosphere cause variation in the electric strength of the air and hence also in the flashover voltage of insulators exposed to the air. Flashover and puncture strength under oil are not affected by these changes.

A-2. CORRECTION FACTORS

A-2.1 When the atmospheric conditions in the neighbourhood of the insulator during the test differ from the reference conditions, adjustments should be made to certain of the test voltages by the application of the following correction factors in accordance with Table 2:

a) *Correction Factor for Air Density* (*d*):

$$d = \frac{0{\cdot}229\, p}{273 + t} \quad (\, d \text{ lies between } 0{\cdot}95 \text{ and } 1{\cdot}05\,)$$

where

p = atmospheric pressure in millibars, and

t = temperature in degrees Celsius.

For a wider range of density and for higher accuracy, instead of *d* the factor *k* shall be used as under. The values of *k* corresponding to factor *d* are given below:

d	*k*
0·70	0·72
0·75	0·77
0·80	0·82
0·85	0·86
0·90	0·91
0·95	0·95
1·00	1·00
1·05	1·05
1·10	1·09
1·15	1·13

b) *Correction Factor for Humidity* (*h*) — Figure 6 gives the absolute humidity value for wet and dry bulb temperatures (when the velocity of air over the wet bulb exceeds 3 m/s) for the standard atmospheric pressure of 1 013 millibars. For better accuracy, a correction should be applied to absolute humidity value obtained from Fig. 6 for any deviation of ambient atmospheric pressure from the standard value of 1 013 millibars. This correction should be obtained from Fig. 7 as follows:

Locate the point corresponding to the deviation of ambient atmospheric pressure from 1 013 millibars on the left hand side of Fig. 7B and join it with right hand side top corner by a straight line. Then locate the point on the curve in Fig. 7A corresponding to the observed value of the differences of dry and wet bulb temperature. Draw a vertical line through this point to intersect the straight line drawn in Fig. 7B. Read the correction to be applied to humidity from the right hand side of Fig. 7B corresponding to the point of intersection. This correction is positive for a positive deviation and negative for negative deviation from the standard atmospheric pressure.

For the corrected value of absolute humidity thus obtained, the correction factor *h* of Table 2 shall be determined from Fig. 8.

TABLE 2 CORRECTION OF VOLTAGES FOR ATMOSPHERIC CONDITIONS

(*Clause* A-2.1)

Test	Adjustment Required
Dry power-frequency withstand test	Voltage applied shall be the appropriate value specified in Table 1 multiplied by *k* and divided by *h*
Dry power-frequency flashover test	Measured voltages shall be divided by *k* and multiplied by *h*
Wet power-frequency withstand test	Voltage applied shall be the appropriate value specified in Table 1 multiplied by *k*
Wet power-frequency flashover test	Measured voltage shall be divided by *k*
Power-frequency puncture withstand test	No adjustment required

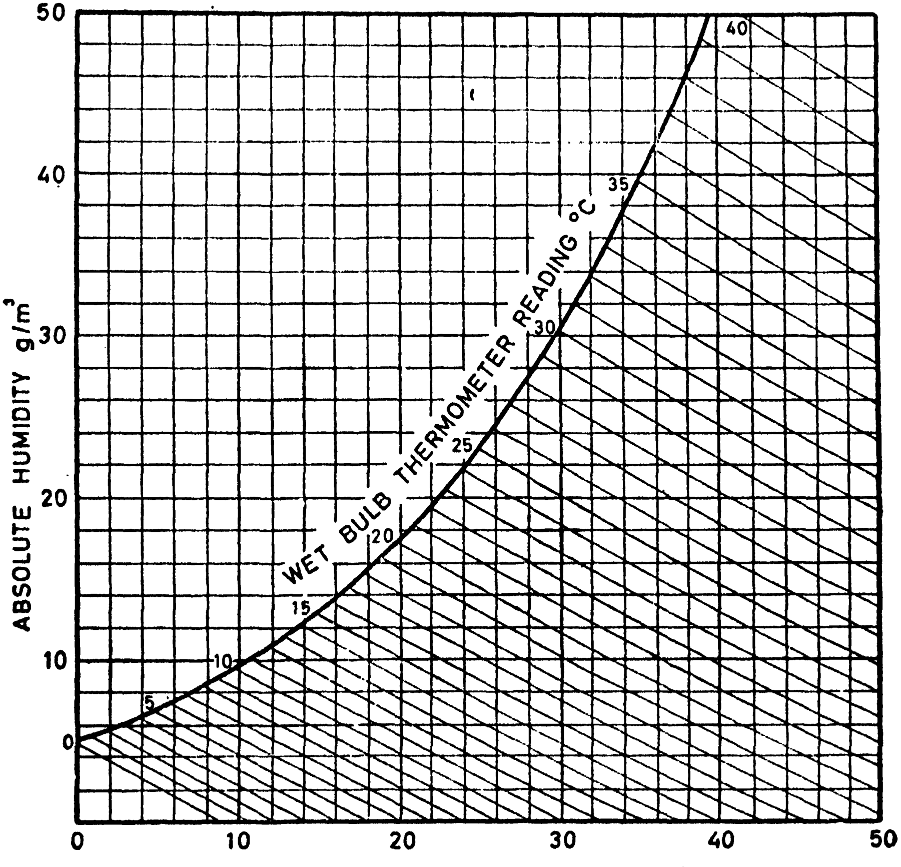
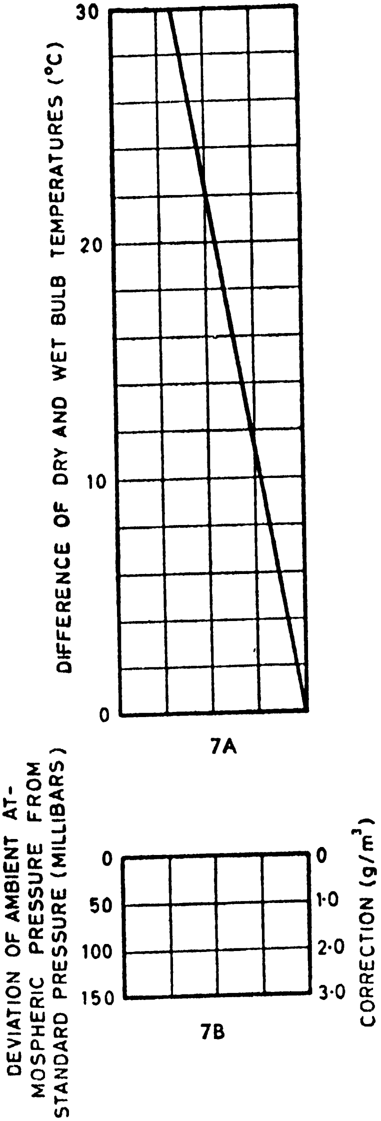


FIG. 6 DETERMINATION OF ABSOLUTE HUMIDITY



7A

7B

FIG. 7 CORRECTION TO ABSOLUTE HUMIDITY FOR VARIATION IN PRESSURE

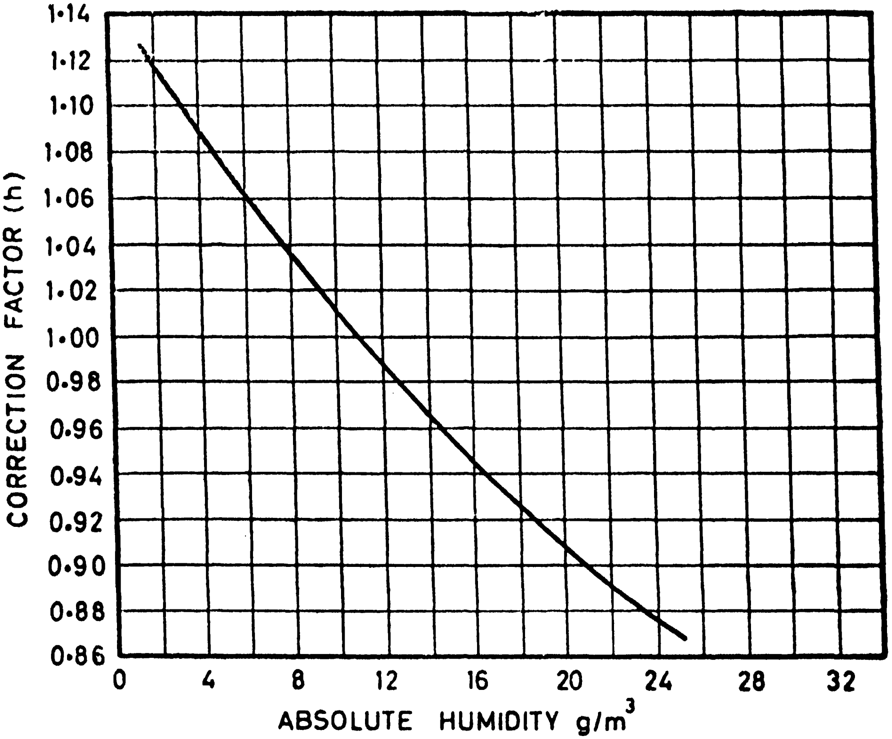


FIG. 8 HUMIDITY CORRECTION FACTOR

APPENDIX B

(*Clause* 8.2.1)

SAMPLING PROCEDURE

B-1. SAMPLE SIZE

B-1.1 The number of insulators to be selected at random from the lot shall be in accordance with col 1 and 2 of Table 3. If required (*see* **B-2**) additional insulators as given in col 3 of Table 3 shall also be selected at random.

B-1.2 All the insulators selected as in **B-1.1** shall be subject to the appropriate acceptance tests.

TABLE 3 SAMPLE SIZE AND CRITERION OF CONFORMITY

(*Clause* B-1.1)

LOT SIZE N (1)	FIRST SAMPLE SIZE n_1 (2)	SECOND SAMPLE SIZE n_2 (3)	ACCEPTANCE NUMBER c_1 (4)	REJECTION NUMBER c_2 (5)
Up to 100	To be agreed between the purchaser and the supplier			
101 to 500	5	10	0	2
501 „ 800	7	14	0	3
801 „ 1 300	10	20	0	3
1 301 „ 3 200	15	30	1	4
3 201 „ 8 000	25	50	2	5
8 001 and above	35	70	2	7

B-2. CRITERION OF CONFORMITY

B-2.1 The lot shall be considered as conforming to the requirements of the acceptance tests if the number of failures found in the first sample n_1 is less than or equal to c_1. If the number of failures is greater than or equal to c_2, the lot shall be considered as not conforming to the requirements of the acceptance tests and shall be rejected. If the number of failures is between c_1 and c_2, and a second sample of n_2 insulators shall be selected and subjected to acceptance tests. If the number of failures in the two samples combined is less than c_2, the lot shall be considered as conforming to the requirements of acceptance tests otherwise it shall be considered to have failed.

APPENDIX C

(*Clauses* 8.6.1, 8.7.1 *and* 8.10.1)

HIGH VOLTAGE TESTS

C-1. ARRANGEMENT OF INSULATOR

C-1.0 General — The insulator shall be clean and dry and in thermal equilibrium with its surroundings.

C-1.1 Pin Insulator

C-1.1.1 The insulator shall be mounted upright on the pin with which it is to be used in service, and the latter shall be fixed to a horizontal metal cross-arm situated at least 1 m above ground and extending at least 1m on each side of the insulator axis. The pin shall be earthed.

C-1.1.2 Alternatively, if the pins are not being supplied by the insulator manufacturer, the insulator may be mounted on an earthed metallic vertical pin with a smooth surface and with a diameter about 4 mm less than that of the insulator pin hole. This pin shall be sufficiently long to ensure that the lowest part of the insulator under test is at least 1 m above ground.

C-1.1.3 A conductor of not less than 5 mm diameter and extending in both directions at least twice the insulator height beyond the top shed shall be secured as nearly as possible horizontally in the insulator side groove by means of a copper binder of 1 mm diameter wrapped round the conductor for a distance such that it extends beyond the insulator, on each side, to a distance approximately equal to the diameter of the top shed.

When the insulator is mounted on the pin with which it is to be used in service, the axis of the conductor shall be at 90° to that of the cross-arm.

C-1.1.4 The test voltage shall be applied between the conductor and the cross-arm.

C-1.2 Shackle Insulators

C-1.2.1 The insulator shall be mounted vertically between and in contact with two smooth metallic straps 40 mm wide and of any suitable thickness. A bolt of suitable diameter shall pass through the axial hole of the insulator and one end of each of the straps. The straps shall extend in one direction from the bolt and shall remain parallel for a distance from the test specimen of not less than the height of the specimen. The other ends of the straps shall be suitably connected to a earthed support.

C-1.2.2 The live electrode shall consist of one turn of 3·25-mm conductor placed around the wire groove and served back on itself. This conductor shall be carried away from the test specimen parallel and in an opposite direction to the supporting straps. The test terminal shall be attached to the end of the conductor.

C-2. POWER-FREQUENCY TESTS

C-2.1 The power-frequency tests shall be made in accordance with IS : 2071 (Part I)-1974* and IS : 2071 (Part II)-1974†.

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*Methods of high voltage testing : Part I General definitions and tests requirements (*first revision*).

†Methods of high voltage testing : Part II Test procedures (*first revision*).

C-2.2 The transformer test circuit shall be such that when the test object is short-circuited at the test voltage, the current is not less than 0·1 A if dry tests are to be made, and not loss than 0·5 A if wet tests are to be made.

C-3. EXCESSIVE HUMIDITY

C-3.1 Precautions shall be taken to avoid formation of dew on the surfaces of the insulator especially when the relative humidity is high (above 85 percent). For example, the insulator should be maintained at the ambient temperature of the test location for sufficient time for equalibrium to be reached before the test commences.

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